

# CGI TOOLS

## Creative Planning and Inspiration

Inspired by MC Escher's Ascending and Descending\* (Wikipedia contributors, 2021) , the visual ‘infinite steps’ effect was achieved in the modelling by referring to the optical illusion principle of the Penrose Steps in the architectural design of Inception. Drawing inspiration from London's iconic Big Ben, I designed a crystal ball scene with bouncing balls, snowflakes and Christmas elements to create the festive atmosphere of Christmas in the UK.



Figure 1 impossible staircase from inception (google)



Figure 2 view of Big Ben (google)

## Related algorithms and computer mapping techniques

### 1. Architectural Modelling :

The architectural model and the staircase were made step by step using the cube's copy, move, zoom, rotate, polyextrude, chamfer formation, insert edge loop tool and other tools.

### 2. Animation Principle :

The sphere bouncing is animated using keyframe animation techniques , using mesh nodes to control the movement , deformation and rotation of the sphere.

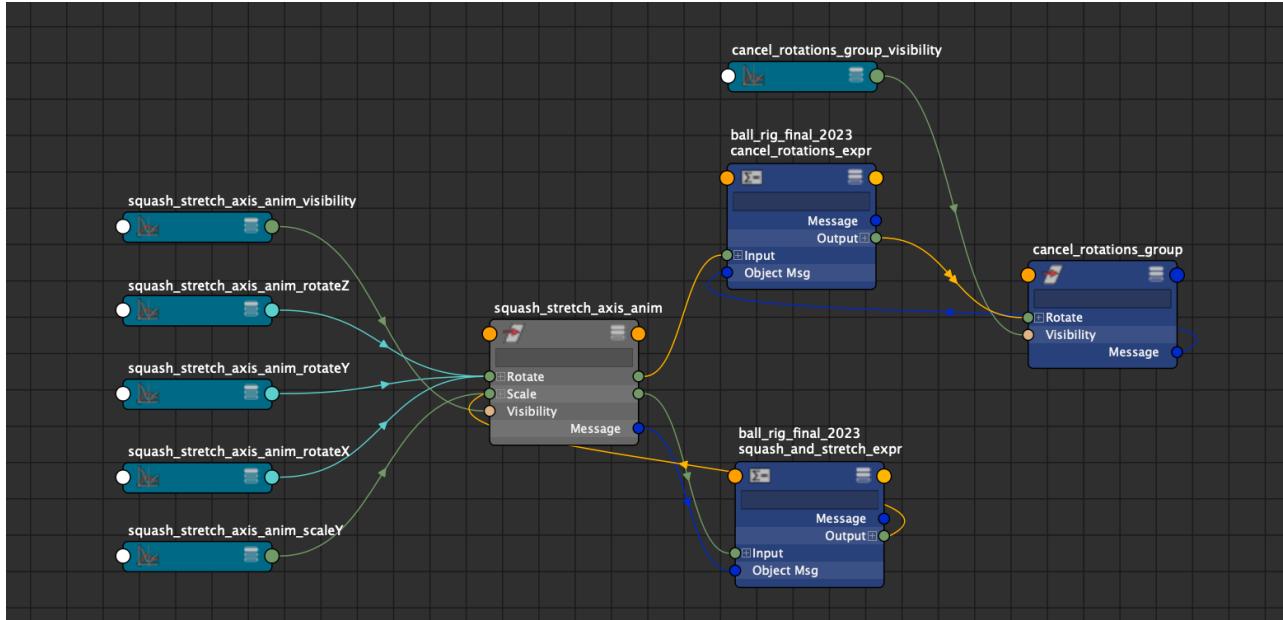


Figure 3 Sphere deformation network node

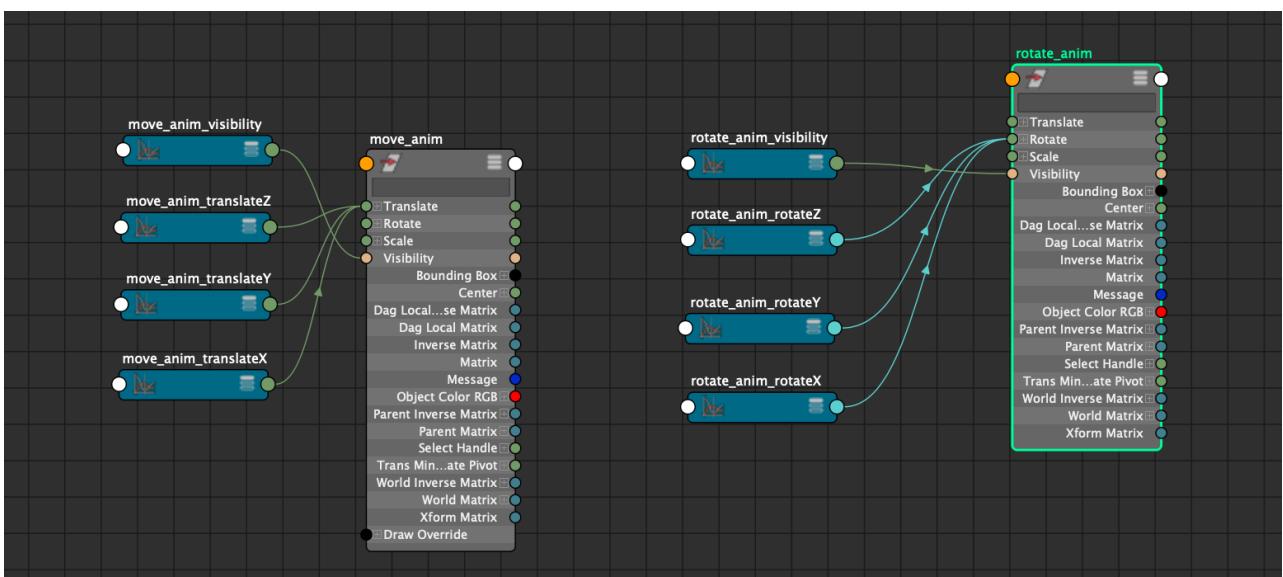
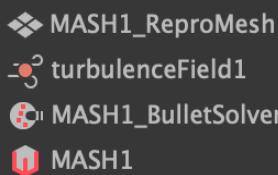


Figure 4 Sphere Mobile Network Node

Materials The crystal ball was generated using Python writing. Renders a glass material by turning off the base colour, adding highlight reflections, enabling transparency, and glass refractive index.

```
# Set basic material properties
cmds.setAttr(f"{{shader}}.base", 0) # Disable diffuse reflection
cmds.setAttr(f"{{shader}}.specular.weight", 1) # Set high reflectivity
cmds.setAttr(f"{{shader}}.specular.roughness", 0) # Smooth reflective surface
cmds.setAttr(f"{{shader}}.specular.IOR", 1.5) # Refraction index for glass
cmds.setAttr(f"{{shader}}.transmission.weight", 1) # Fully transparent
cmds.setAttr(f"{{shader}}.transmission.IOR", 1.5) # Refraction index for glass
cmds.setAttr(f"{{shader}}.transmission.color", 1, 1, 1, type="double3") # Pure transparency
```



To achieve the snowflake effect inside the crystal ball, I used Maya's MASH system. The snowflake model was first created and instantiated as multiple snowflakes through the MASH network. Then, a Bullet Solver node was added using MASH

Dynamics to give the snowflakes a physical simulation. A Turbulence Field is introduced to give the snowflakes a random fluttering effect to simulate wind disturbances. Finally, the distribution range and dynamic parameters of the snowflakes are adjusted to make them float freely inside the sphere, showing a natural snow effect.

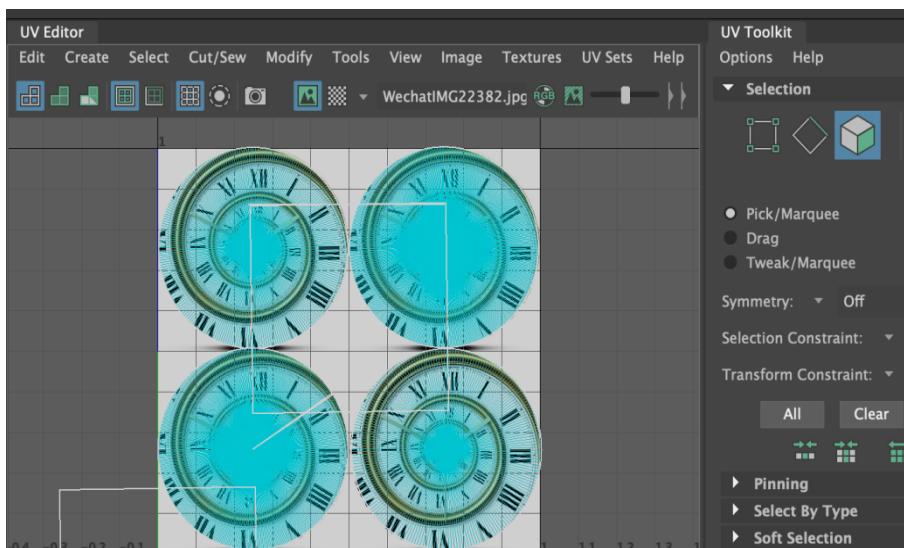


Figure 5 Project camera view

The architectural surfaces were created using Lambert's Custom Materials; the green textures on the crystal ball base and Christmas tree were enhanced using aiStandardSurface file import and three-point lighting.



Figure 6 Christmas Tree Texture Chart



The clock is adjusted by the UV editor and then made on a flat surface aiStandardSurface in the file way.

Figure

7 UV Editor Diagram

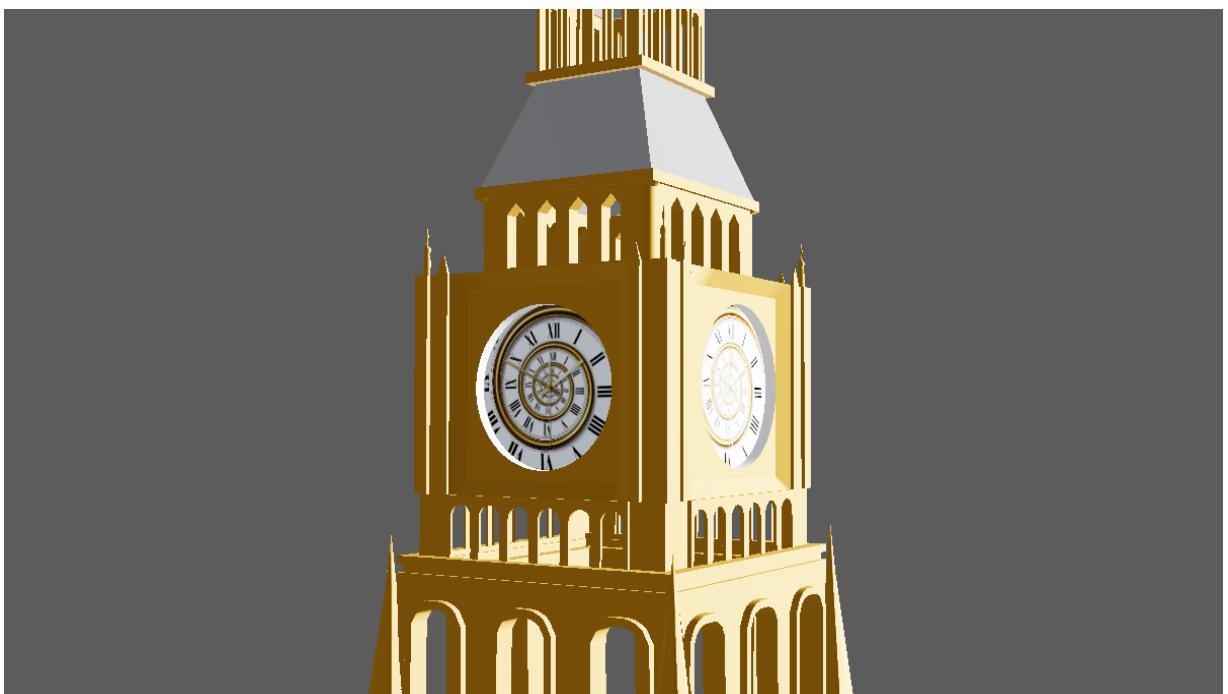
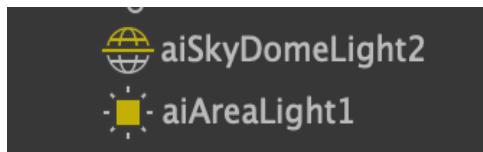


Figure 8 Clock diagram of the face of Big Ben

## Lighting reference



aiSkyDomeLight is used to illuminate the entire scene, providing a soft global lighting effect. aiAreaLight produces softer shadows, increasing the detail of light and shadow in specific areas.

## Compositional methods

The staircase and the main movement area of the ball are located in the focal points of the trichotomy, attracting the viewer's attention.

## Self-reflection

The part of this project that needs improvement is the material details, which can be further optimised, such as adjusting the reflectivity and texture details to enhance the visual realism. In addition, the subtle deformation when the ball rotates could be more natural, and more complex animation effects could be achieved in the future by adjusting the node network. Through this project, I have gained an in-depth understanding of procedural modelling, the use of node editor and the practical application of animation principles, and at the same time, I also realise that I haven't gone deep enough in this part of the study, and that I don't understand some parts thoroughly. So I need to practice and create more after class and accumulate more knowledge by watching related videos and books.

## References

Cheng, J.-H., Chen, Y., Chang, T.-Y., Lin, H.-E., Wang, P.-Y.C., and Cheng, L.-P. (2021) 'Impossible Staircase: Vertically Real Walking in an Infinite Virtual Tower', *IEEE Virtual Reality and 3D User Interfaces (VR)*, 2021(1), pp. 50–56.

Wikipedia contributors (2021) *Ascending and Descending*. [Online]. Available at: [https://en.wikipedia.org/wiki/Ascending\\_and\\_Descending](https://en.wikipedia.org/wiki/Ascending_and_Descending) (Accessed: 14 January 2025).